Jet Analysis: Comparing Jets from Pythia Simulations and Reconstructed Tracks Ran Through Pisa

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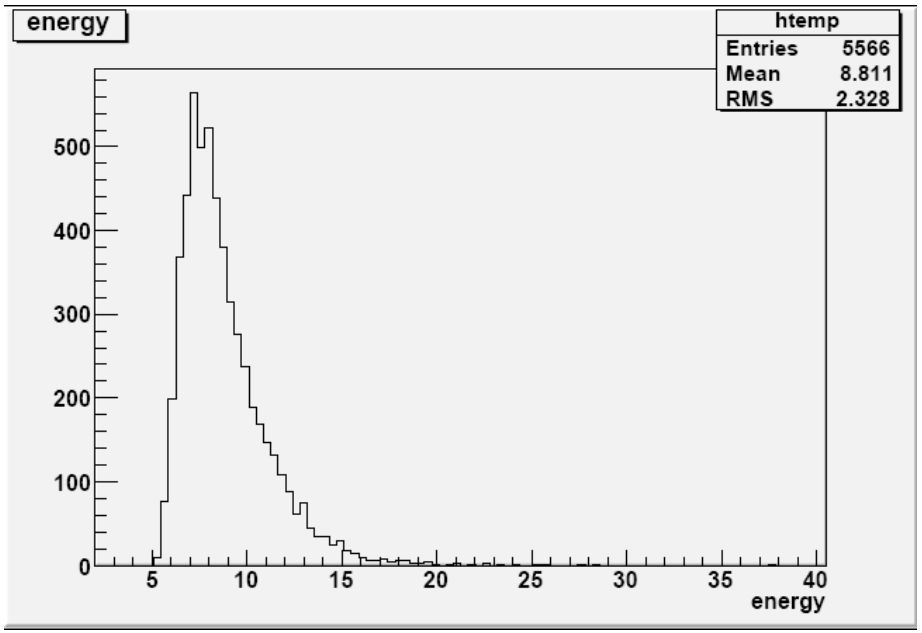
Analyzing the PYTHIA Events

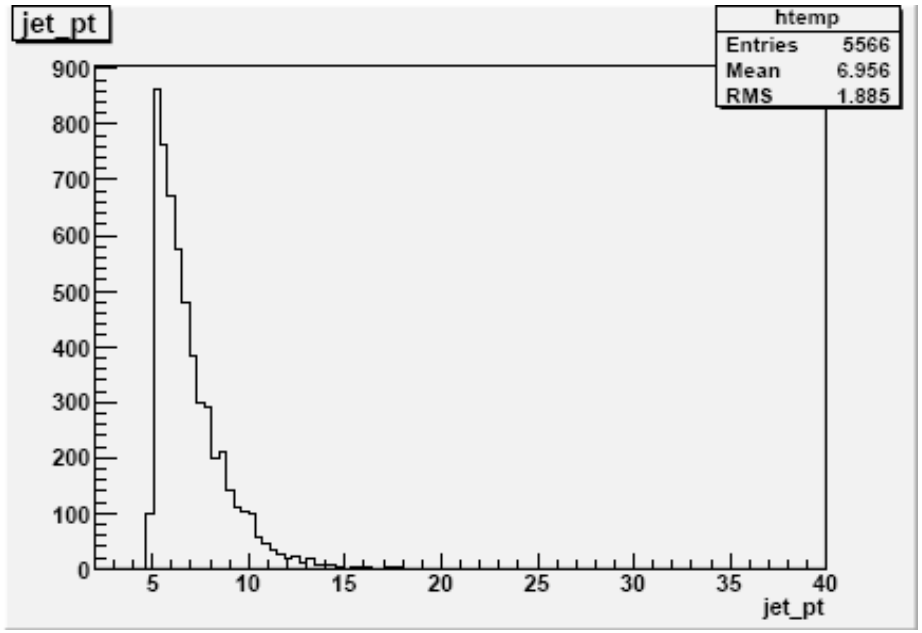
- Look at events generated by PYTHIA
- Run these events through the Fastjet Algorithm
  - We used the kt-algorithm
- Collect the properties into an Ntuple
  - Energy, pt, pseudorapidity, and phi
- Find the hard scattered parton that produced the jet
  - We used the parton that was closest to the jet with respect to its direction
    - This was done using the scalar product of the directions of the momentum vectors
- Find the properties of the parton
- Compare the properties of the jet with those of the parton

Results of Initial PYTHIA Analysis

- The following are the distributions of the properties of the jets found from the PYTHIA events
  - Particles sent through the jet finding algorithm were restricted to those with eta between -1 and 1

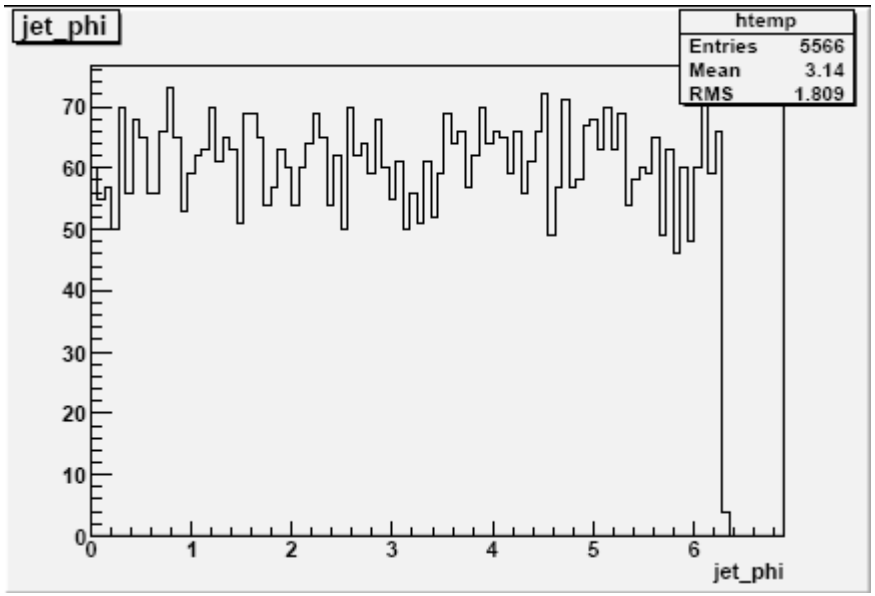


Energy of Jets

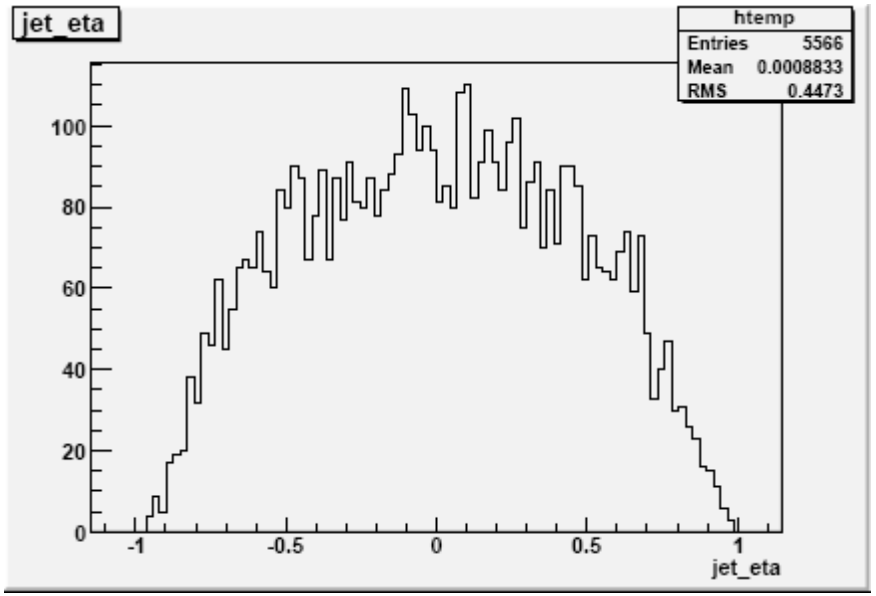


Pt of Jets

More Jet Properties

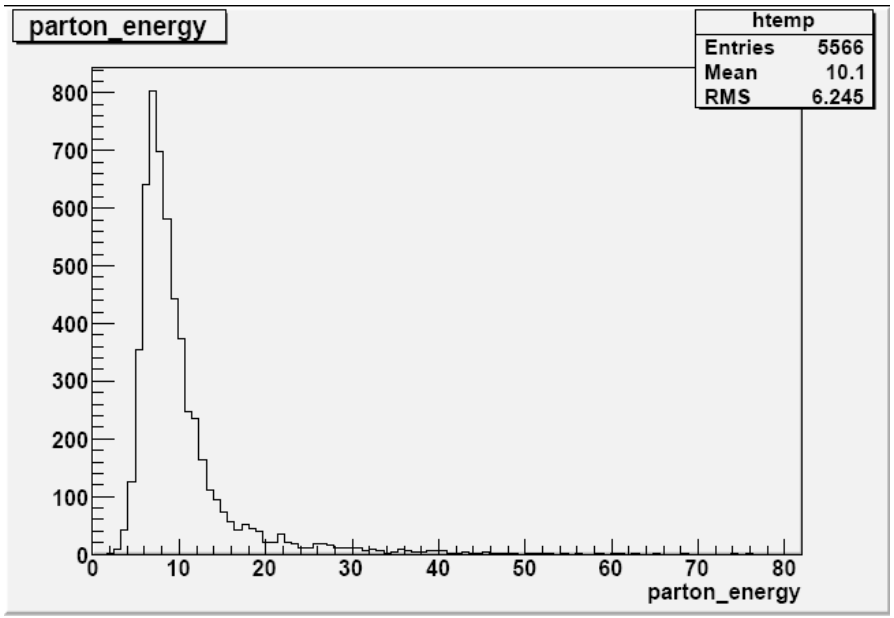


Phi distribution of jets

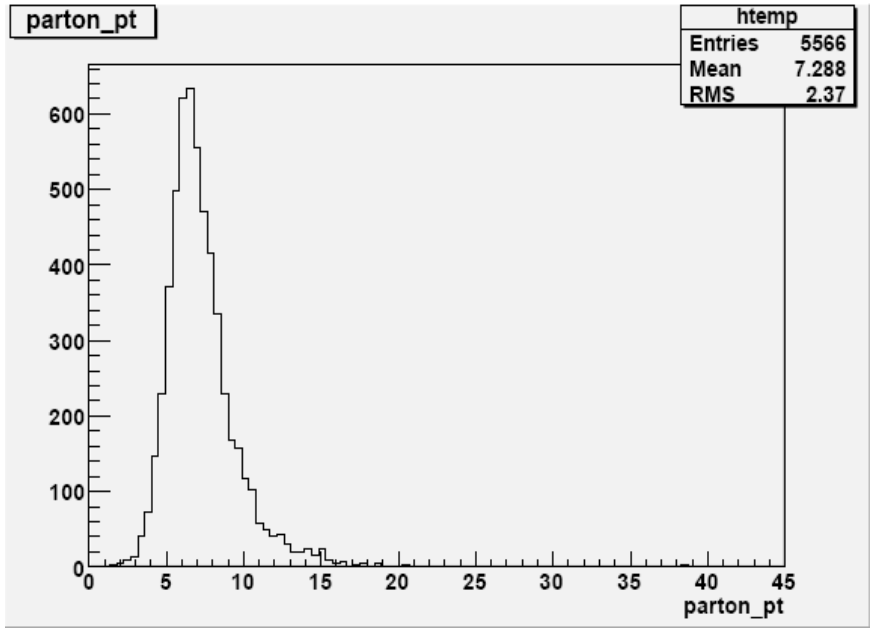


Eta distribution of jets

Properties of the Partons

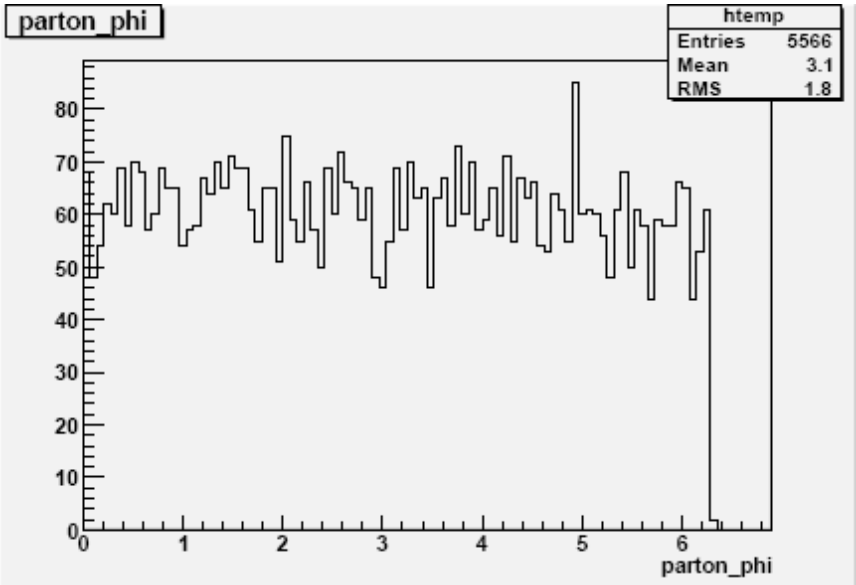


Energy of Partons

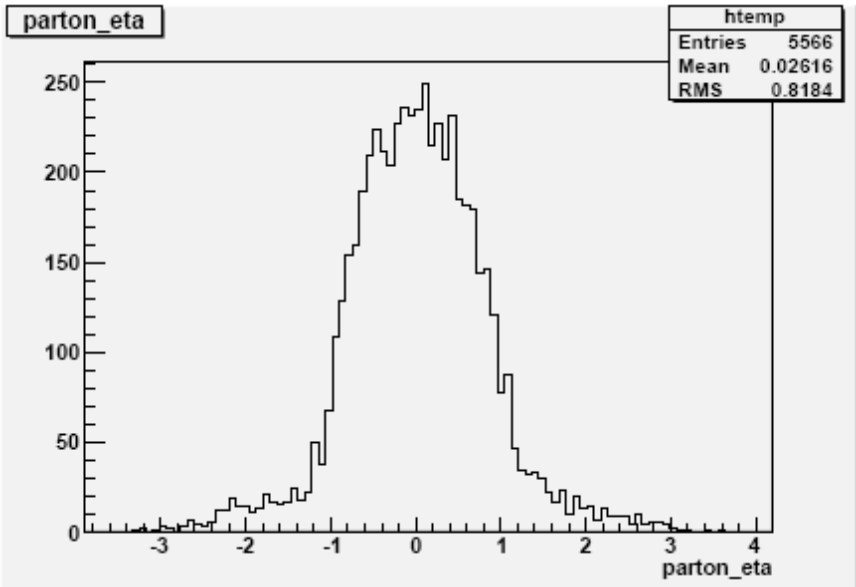


Pt of the Partons

More Parton Properties



Phi Distribution of Partons

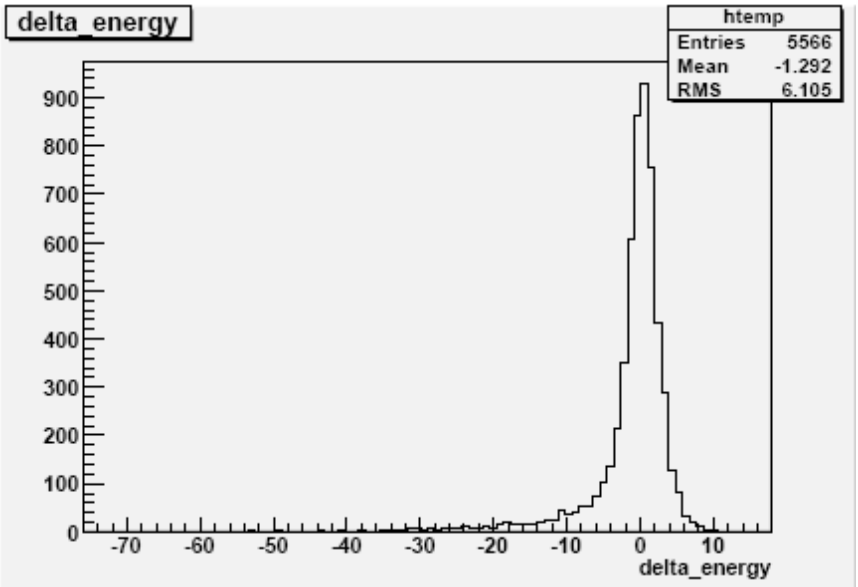


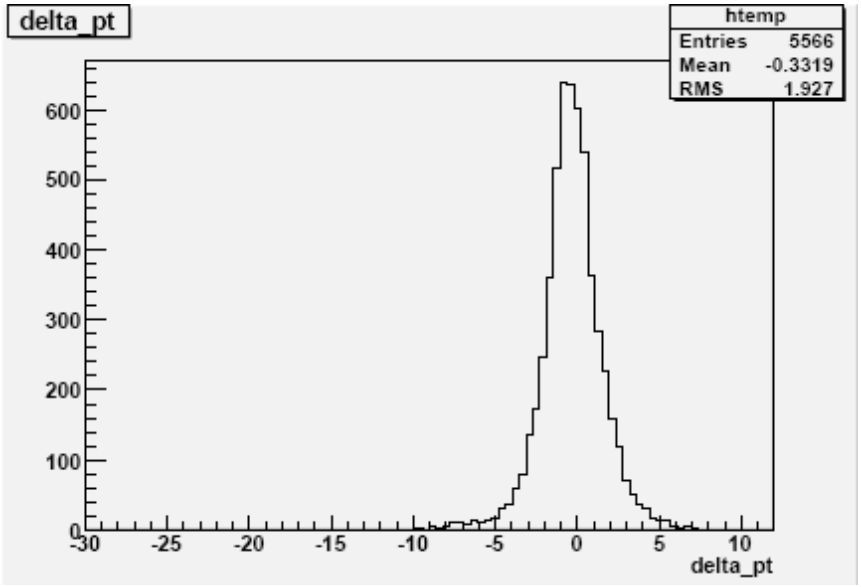
Eta Distribution of Partons

How do the Jets Found in the PYTHIA Events Compare to Their Partons

- Next we compared the Jets that were found to the parton that was closest in angle
- We did this for every jet found within an event
- In the 2 to 2 events we run into the issue of deciding which parton produced the jet
- To decide which was closest we used the scaler product to find the angle between the direction of the jet and the partons and chose the parton that had the smaller angle with the jet
  - This was done using spherical coordinates using the pseudorapidity to find theta and phi was given based on the momentum in the x and y directions
- The following slides show how the properties of the jets compare to the partons

Distributions of Differences Between the Jets and the Partons

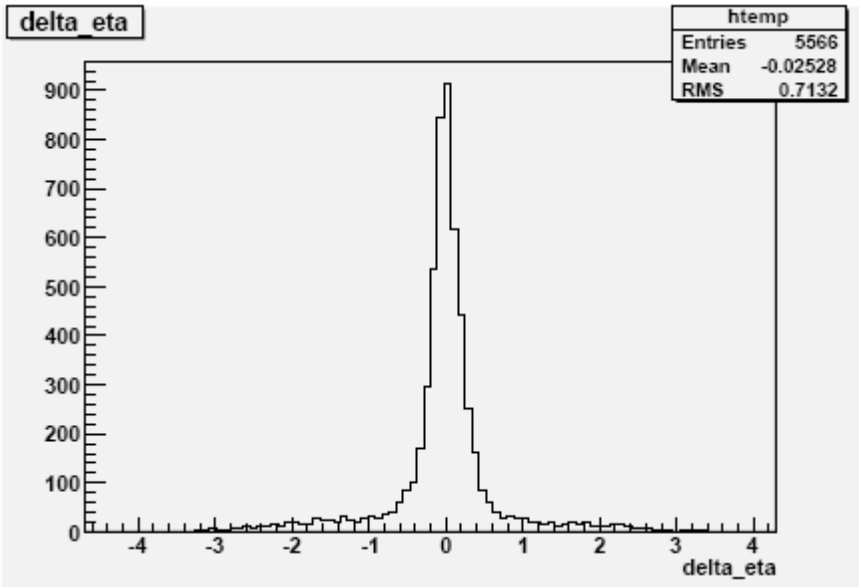


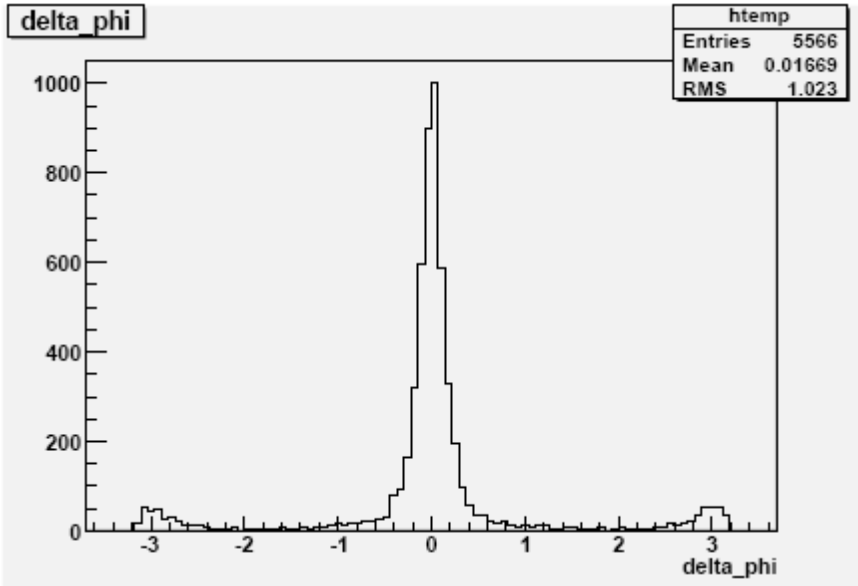


Delta Energy =
Jet Energy - Parton Energy

Delta Pt =
Jet Pt - Parton Pt

More Differences Between the Jets and the Partons





Delta Eta =
Jet Eta - Parton Eta

Delta Phi =
Jet Phi - Parton Phi

Tails on Delta Phi, Delta Eta, and Parton Eta Distributions

- There are small peaks on the delta phi distributions at positive and negative pi
- There are tails on the Delta Eta distribution beyond positive and negative one
- There are tails on the Parton Eta distribution beyond positive and negative one despite the restriction of only using particles with eta between positive and negative one
- We need to look into these tails and their causes

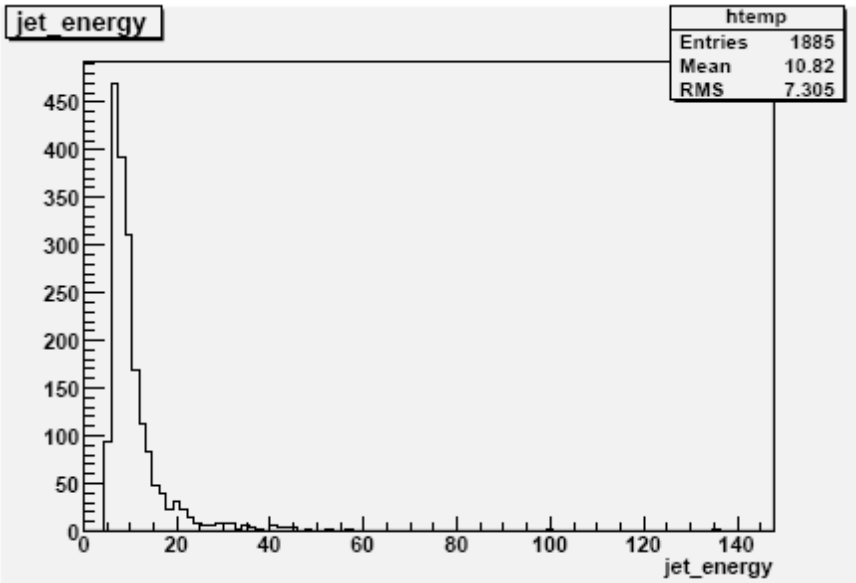
Possible Causes of These Tails

- There may be cases where the initial parton was mis-identified
- There may have only been one jet detected when there should have been two or three
- This is one thing that will have to be investigated further

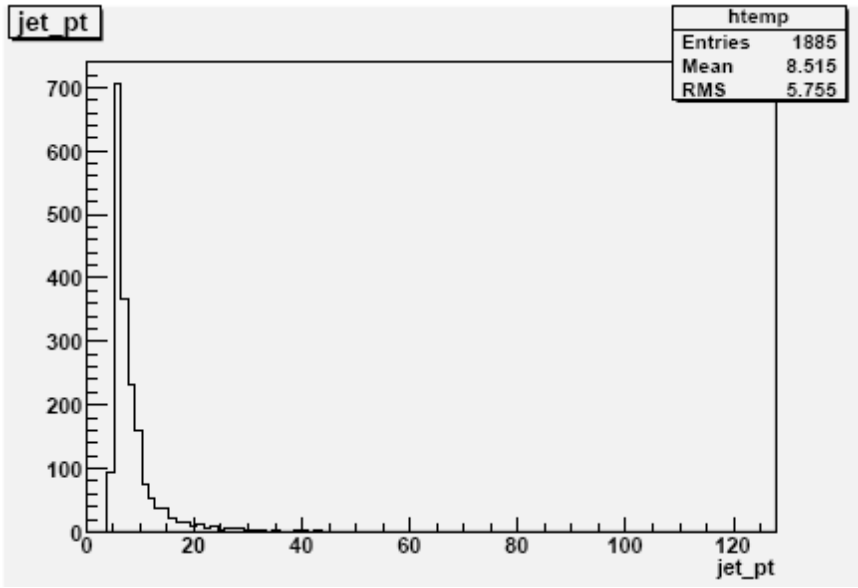
What's Next?

- Following the analysis the jets of the PYTHIA events Alan Dion ran the same PYTHIA events through PISA and reconstructed the tracks using the stand alone tracking
- He then sent the reconstructed tracks for the first 10,000 events in the phpythia.root file I used for the previous analysis
- The events we were given corresponded 1 to 1 with the PYTHIA events
- The method of analysis is the same as described in slide 2
- The slides that follow will summarize those findings

Properties of the Jets found from the Reconstructed Tracks

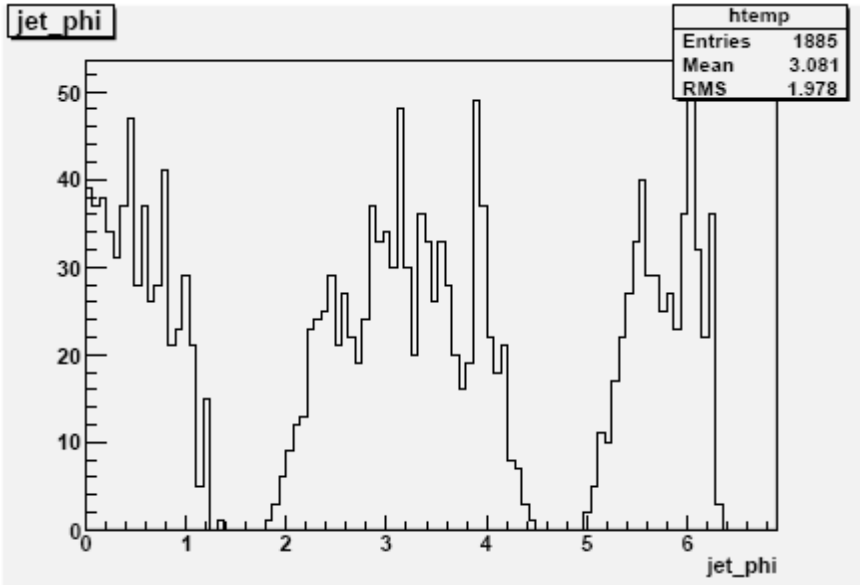


Energy of Jets

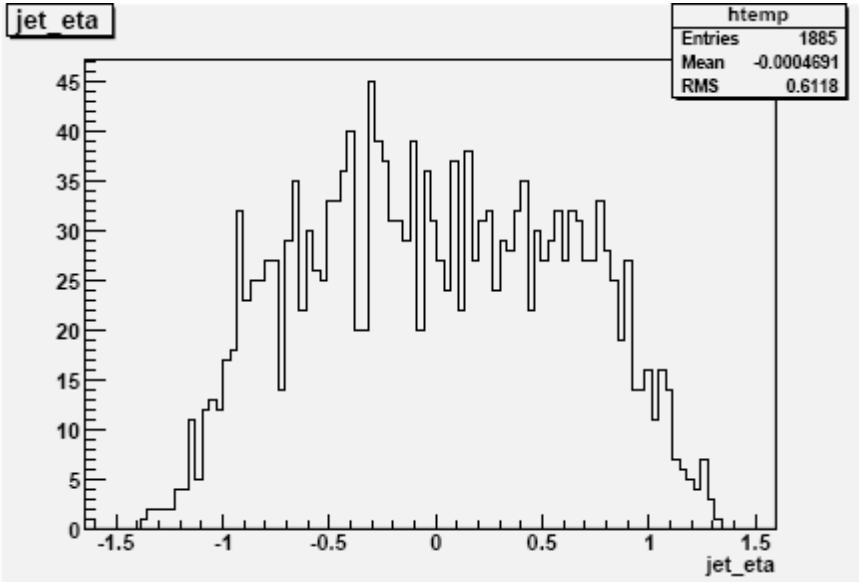


Pt of Jets

More Properties of Jets from the Reconstructed Tracks



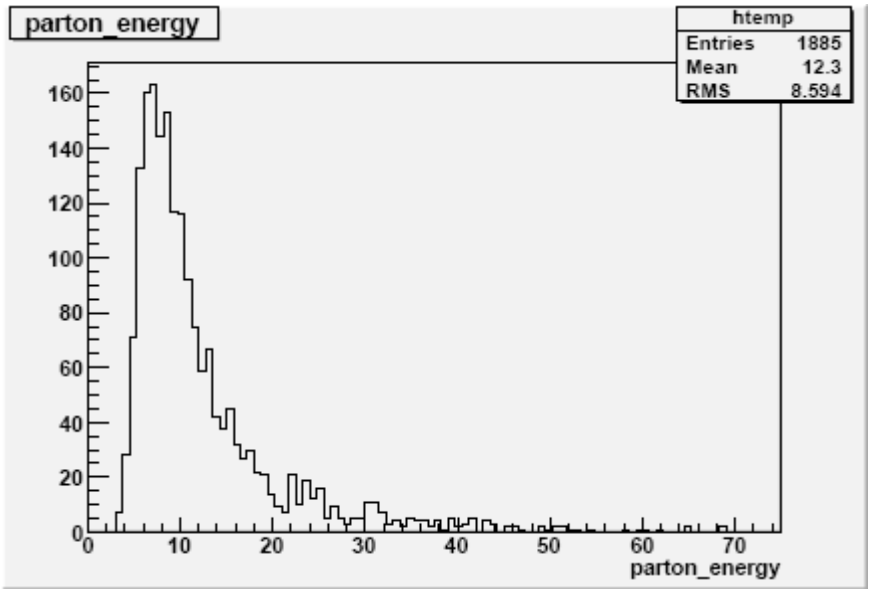
Phi of Jets



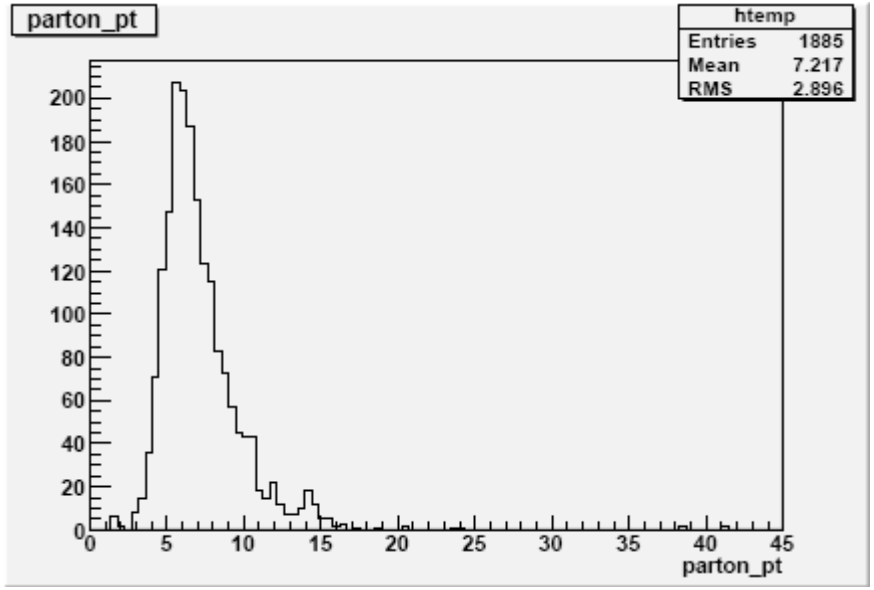
Eta of Jets

Properties of the Partons

The following are the properties of the partons we paired with the jets

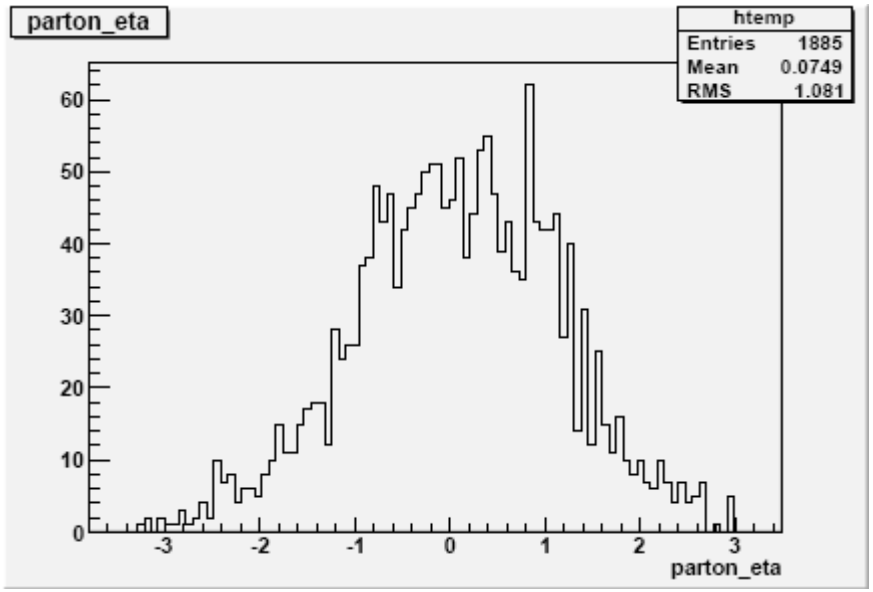


Energy of Partons

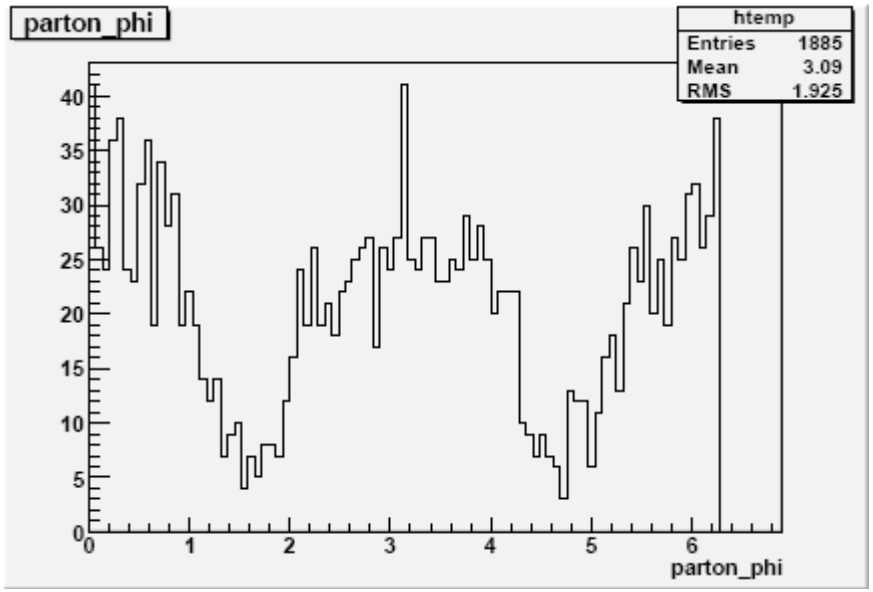


Pt of Partons

More Parton Properties

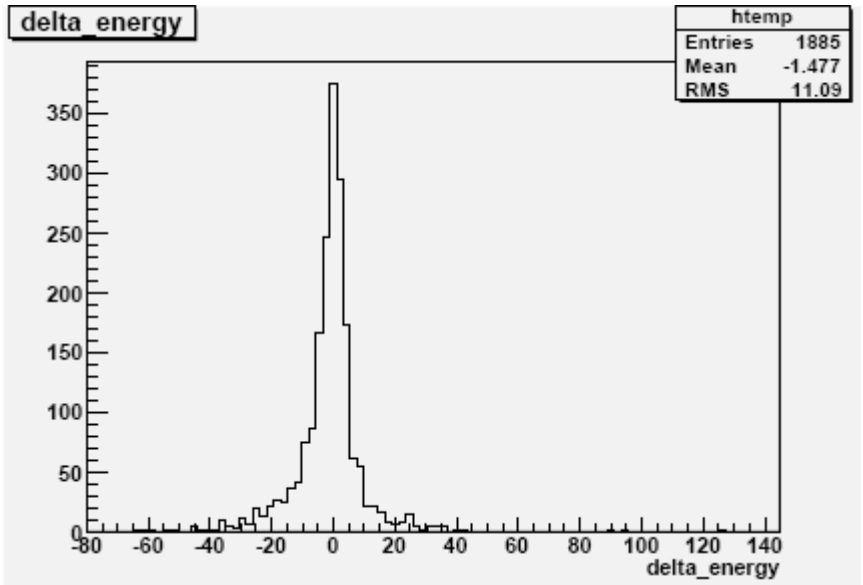


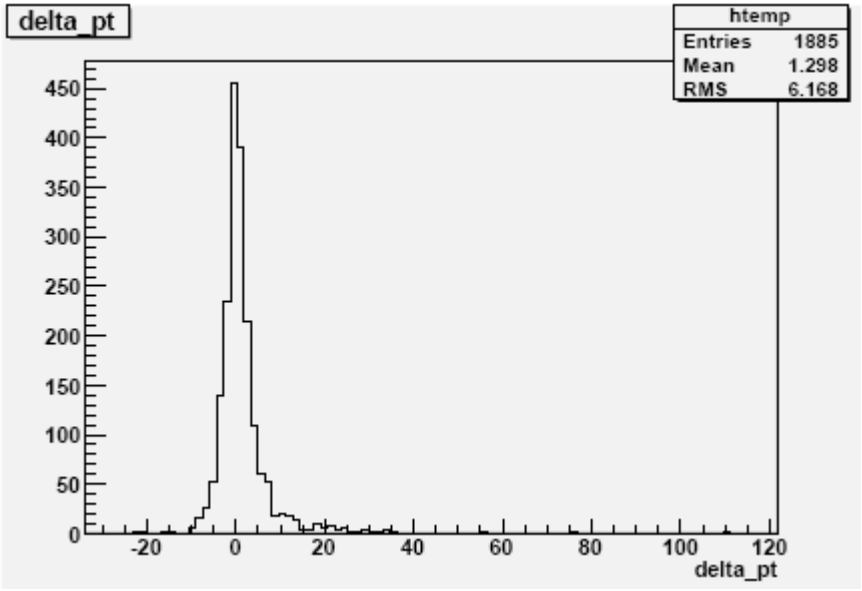
Eta of Partons



Phi of Partons

Comparing the Jets from the Reconstructed Tracks to the Partons

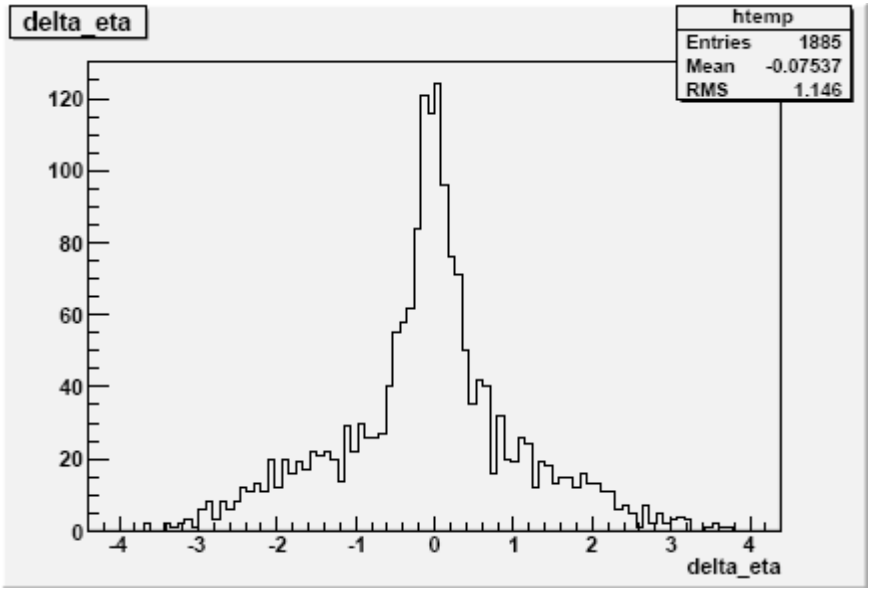


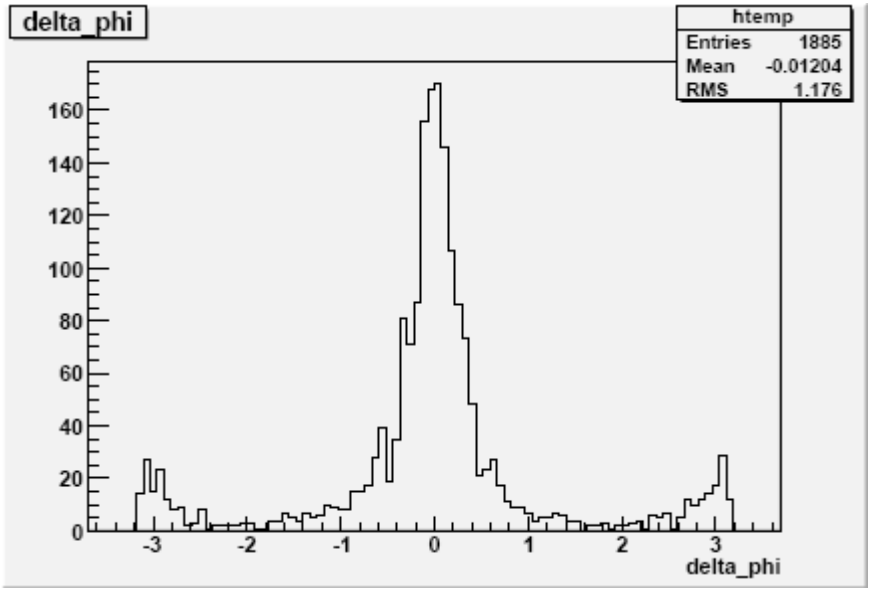


Delta Energy =
Jet Energy - Parton Energy

Delta Pt =
Jet Pt - Parton Pt

A Few More Comparisons





Delta Eta =
Jet Eta - Parton Eta

Delta Phi =
Jet Phi - Parton Phi

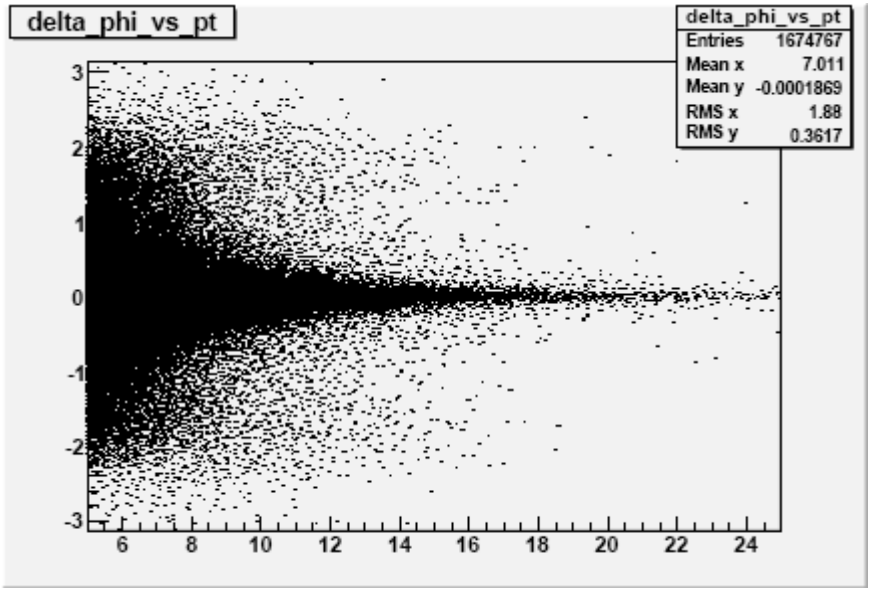
How do these differences depend on the Jet properties

- We are interested in a number of other relations
- Some that we investigated
  - Delta Phi vs Pt of the Jet
  - Delta Eta vs Pt of the Jet
- Others we are investigating
  - Delta Eta vs Eta of Jet
    - This is done with to the reconstructed tracks so that we can make fiducial cuts when we look at real data

How Does Delta Phi Depend on the Transverse Momentum of the Jet?

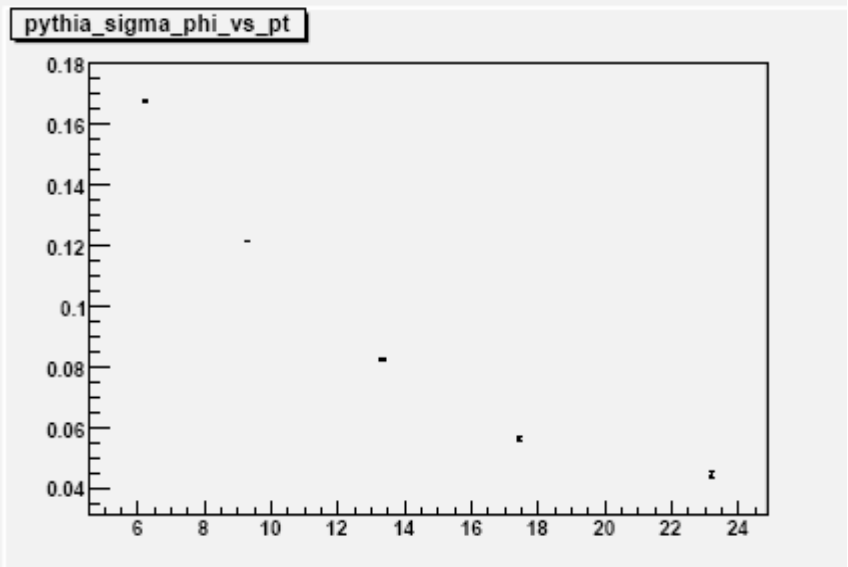
- We used 3 million of the minbias phpythia events stored in the raid arrays
- Did the same analysis on these as we described on slide 2
- The jet algorithm gave no jets with pt below 4.5 GeV
- We separated the jets into bins starting at 4 GeV that were 4 GeV wide
  - The bins used were 4-8,8-12,12-16,16-20, and pt>20 GeV
- Once they were separated into the bins we looked at the distribution of delta phi for each bin
- We then fit a Gaussian to each of the distributions to obtain a measure of the width
- The following slides summarize the results

Width of Delta Phi vs Pt of the Jet



X-axis = Pt of Jet

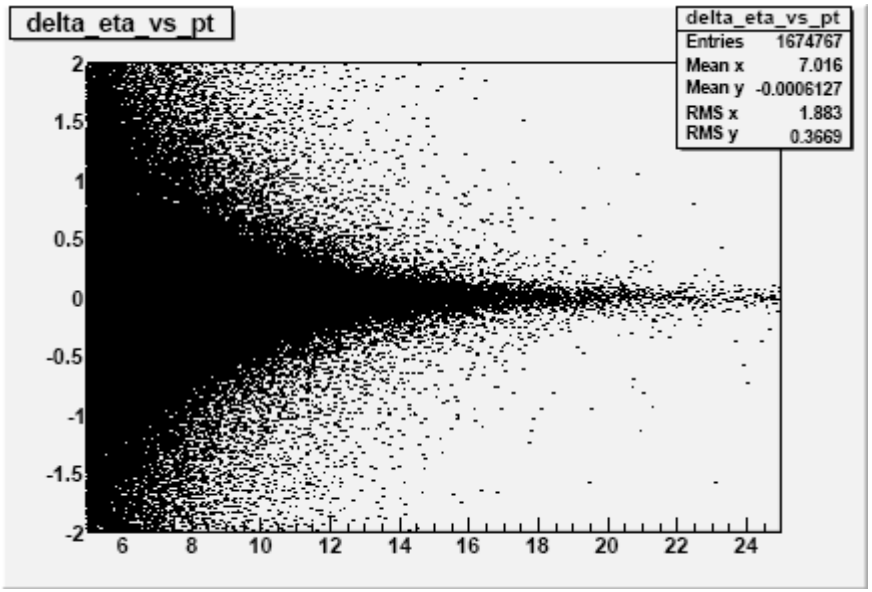
Y-axis = Delta Phi
(Delta Phi = Phi of Jet – Phi of Parton)

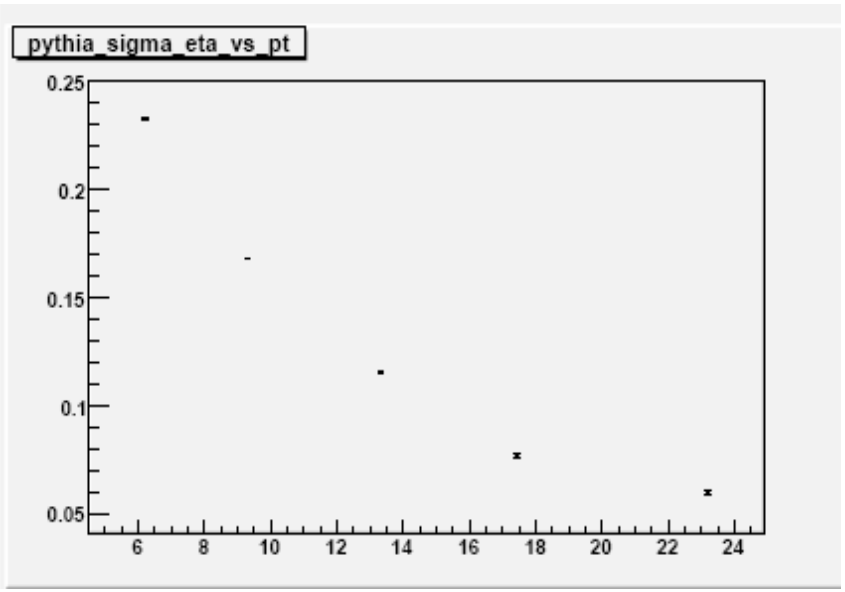


X-axis = Pt of Jet

Y-axis = Sigma of Gaussian fit of Delta Phi

Width of Delta Eta vs Pt of the Jet





X-axis = Pt of Jet

Y-axis = Delta Eta
(Delta Eta = Eta of Jet – Eta of Parton)

X-axis = Pt of Jet

Y-axis = Sigma of Gaussian fit of Delta Eta

Summary

- Applied the FastJet Algorithm to PYTHIA events then again to PYTHIA events that were run through PISA followed by reconstructed tracks
- Jet angle resolution is broader after reconstruction and PISA then for PYTHIA events
- Need to find out what is happening in events with large delta eta and delta phi
- Still need to look into the resolutions of the the events after PISA and track reconstruction as well as their dependence on Pt and collision position